(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 February 2002 (21.02.2002)

PCT

(10) International Publication Number
WO 02/14100 A1

(51) International Patent Classification[7]: B60N 2/00

(21) International Application Number: PCT/EP01/09288

(22) International Filing Date: 10 August 2001 (10.08.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
90630 11 August 2000 (11.08.2000) LU

(71) Applicant *(for all designated States except US)*: **I.E.E. INTERNATIONAL ELECTRONICS & ENGINEERING S.À R.L.** [LU/LU]; Zone Industrielle Findel, 2b, route de Trèves, L-2632 Luxembourg (LU).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **RUGGIU, Manuel** [LU/LU]; 94, rue de la Libération, L-4798 Linger (LU). **AVDIU, Fahri** [YU/LU]; 100, route de Luxembourg, L-6450 Echternach (LU).

(74) Agents: **BEISSEL, Jean** et al.; Office Ernest T. Freylinger S.A., B.P. 48, L-8001 Strassen (LU).

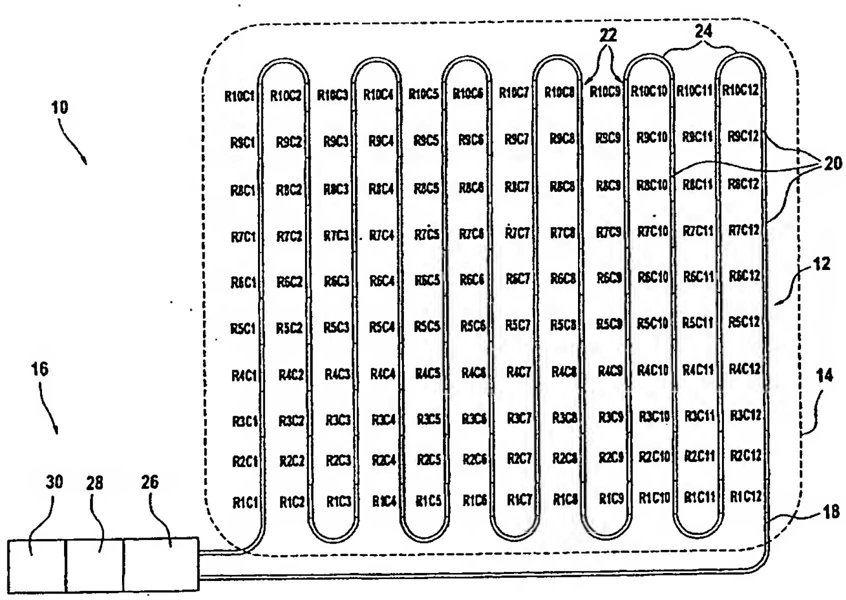
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: SEAT OCCUPANT DETECTION DEVICE



(57) Abstract: A device for sensing occupancy of a seat comprises at least one optical fibre means (12), which extends over at least a part of a seating surface of said seat, and detecting means for detecting a loss of optical energy in said optical fibre means.

WO 02/14100 A1

Seat Occupant Detection Device

Introduction

The present invention relates to a device for sensing occupancy of a seat, especially a vehicle seat, e.g. for controlling a secondary restraint system such as an airbag.

Modern vehicles are usually equipped with a plurality of airbags for protecting the vehicle passengers in case of an accident. In order to minimise the repair costs after such an accident, car manufacturers try to limit the deployment of the airbags to those, which are necessary with respect to the actual crash situation. The crash situation and the occupancy of the different vehicle seats have to be considered in order to determine which airbag has to deploy.

In order to detect the seat occupancy of the vehicle seats, especially the passenger seat, passenger presence detectors are often integrated into the vehicle seat, which comprise several pressure sensitive cells arranged on a supporting structure. The pressure sensitive cells usually comprise foil-type pressure sensors with two supporting foils, which are sandwiched by means of a spacer. Two electrode structures are arranged on the supporting foils, which are contacted by a pressure sensitive layer if the sensor is activated, so that the electrical resistance of the sensor decreases with increasing pressure.

These passenger detection sensors work very reliably, however their switching characteristic is subject to environmental conditions such as ambient air pressure and humidity. While the individual effect of each of these environmental factors can easily be eliminated, the individual measures are however rather incompatible. It follows that the elimination of the combined effects requires a more elaborate and accordingly more expensive solution.

Object of the invention

The object of the present invention is to provide a device for sensing occupancy of a seat, the sensitivity of which is to a large extend independent from environment factors.

General description of the invention

In order to overcome the above-mentioned problems, the present invention proposes a device for sensing occupancy of a seat, comprising at least one optical fibre means, which extends over at least a part of a seating surface of said seat, and detecting means for detecting a loss of optical energy in said optical fibre means. The optical fibre means, which extends at least over a part of the seating surface of the seat, has a specific form and location when the seat is not occupied. If a passenger sits down on the seat, the seating surface is elastically deformed and this optical fibre means is deformed resp. displaced from its original location. By detecting an optical loss in said optical fibre due to a deformation or a displacement of the optical fibre means respectively by detecting a variation of loss of optical energy due to the deformation or displacement of the fibre means the occupancy of the seat can be reliably detected.

Transmission losses of an optical energy through an optical fibre and reflection losses of an optical energy inside an optical fibre respectively are totally independent from air pressure or ambient humidity. Furthermore the transmission characteristic of an optical fibre means is influenced neither by changes in ambient temperature, nor by electromagnetic interference. It follows that the use of a device according to the present invention allows for very reliable detection of seat occupancy independently on any environmental conditions, which could disturb the seat sensors known in the prior art.

In a first very simple embodiment, the optical fibre means comprises at least one optical fibre, which extends at least over a part of said seating surface, so that said optical fibre is deformed when said seat is occupied by a passenger. In

this case, said detecting means comprises means for detecting a loss of optical energy in said fibre due to a deformation, e.g. bending, of said fibre.

A simple optical fibre has a specific optical transmission characteristic, which can be described by the formula $P_0 = k * P_i$, wherein P_0 denotes the output optical power, P_i represents the input optical power and k represents the attenuation. The attenuation factor is depending of different factors such as impurities of glass, chromatic dispersion, imperfect cladding, fibre splicing or fibre bending. While the first three mentioned losses depend entirely from fibre fabrication, the latter two losses can be used for detecting the occupancy of a seat.

When a fibre is sufficiently bent, some amount of the light in the core no longer meets the cladding at an angle equal to or greater then the critical angle. Therefore, total internal reflection (TIR) does not occur, and a part of the initial light beam leaves the core. The amount of energy lost due to fibre bending may be measured at the end of the fibre. Bending may be caused for example by applied weight on fibre.

Thus, an optical fibre, which shows a predetermined attenuation characteristic when the seat is not occupied, will change its attenuation coefficient k, if a passenger sits down on the seat. By detecting a variation of the loss of optical energy in the fibre, one can consequently conclude to a change in the occupancy of the seat.

It should be clear, that occupancy of the seat is detected by a change in the transmission characteristic of the optical fibre between the initial state, when the seat is not occupied, and the deformed state, when the seat is occupied. Thus the detecting method is based on a comparison of two relative values and a precise determination of the actual attenuation coefficient is not necessary. It has to be noted that the optical fibre may be bend already in its initial state. It can e.g. extend in several meanderings over the seating surface. While the meanderings imply bending of the fibre substantially in a plane of the seating surface, occupancy of the seat causes additional bending of the fibre mostly in a vertical direction. The additional loss of optical energy due to this "vertical"

bending can be detected by detecting means and is indicative of an occupied state of the seat.

It has to be noted, that the detecting means can e.g. comprise light emitting means, which are coupled to a first end of the optical fibre, and light detecting means, which are coupled to a second end of said optical fibre. The light emitting means emits light pulses into said optical fibre, which are then transmitted through said optical fibre towards the light detecting means. A difference of optical energy between said emitted light and said received light can be calculated and compared to the predetermined loss of the fibre in its initial form, i.e. to the loss in case of a non-occupied seat. If the optical energy of the emitted light pulses is constant, it is even sufficient to simply monitor the output signal of the light detecting means, a change in the output signal indicating a change in the occupancy status of the seat.

It should be appreciated that the use of several optical fibres, each of which extends over a specific part of the seating surface, advantageously permits to detect occupancy independently for the different parts of the seating surface. Furthermore by determining the amount of energy loss due to the "vertical" bending in each of the optical fibres, it is possible to record a seating profile, which indicates how much each part of the seating surface is deformed by a passenger. This seating profile can then be used to classify the seat occupancy in one of several classes and to control the deployment of a secondary restraint system in a mode specific for this class.

In a more evolved embodiment, said optical fibre comprises at least two optical fibre portions, which are assembled in series, and said detecting means comprises means for detecting a loss of optical energy in each of said optical fibre portions. In other words, the optical fibre means comprises a spliced fibre, which extends over the seating surface of said seat. In a spliced fibre, losses of optical energy are among others caused by reflection of certain amount of energy at a boundary surface between two spliced fibre portions. Though small, this energy is measurable. Together with the bending losses, the reflected part of energy can be used to determine the overall energy losses in each of the

fibre portions of the spliced fibre. This permits not only to detect a change in the overall attenuation characteristic of the fibre optic means, but also to locate the fibre portions, in which this change has occurred.

By suitably arranging the two or more fibre portions on the seat surface, this embodiment of the device for detecting occupancy hence permits not only to detect a seat occupancy, but also to locate the parts of the seating surface, which are actually occupied. If the amount of attenuation caused by bending is determined for each fibre portion, the device for detecting occupancy can even be used to record a seating profile. In other words, it will be possible to record the amount of pressure exerted by a passenger on the different parts of the seating surface associated to the different fibre portions. This seating profile or weight profile can be used to classify the passenger in one of several weight classes and to control a secondary restraint system accordingly.

It has to be noted that for this embodiment, the detecting means comprises advantageously light emitting means and light detecting means, which are coupled to a first end of the optical fibre. The light emitting means emits light pulses into said optical fibre, which are then transmitted through said optical fibre, whereby a part of the optical energy is reflected at each splice boundary. The reflected energy propagates through the fibre towards the first end and is detected by the light detecting means. A difference of reflected optical energy between the non-bend fibre and the bend fibre can be used to detect occupancy of the different fibre portions. It will be appreciated that a further light detecting means can be provided at the second end of said fibre for detecting light transmitted through said optical fibre means.

The detecting means preferably comprises an optical time domain reflectometer. An optical time domain reflectometer (OTDR) is an optoelectronic instrument used to characterise an optical fibre An OTDR injects a series of optical pulses into the fibre under test. It also extracts, from the same end of the fibre, light that is scattered back and reflected back. The intensity of the return pulses is measured and integrated as a function of time, and is plotted as a function of fibre length.

Depending on the pressure (weight) applied on the different fibre portions, there will be different bending and therefore different losses. These losses may be localised using OTDR based devise, which can measure the losses on different sections and splice losses. Though the reflected energy can be as small as one millionth of the transmitted optical energy, the resolution of OTDR based devices is so high that it can detect the splice position and respective losses.

Accordingly, each section of the fibre represents one active area of a pressure sensor. The resolution of this pressure sensor can be increased by increasing the number of the different fibre sections. By suitably arranging the different fibre sections of the optical fibre on the seating surface, a grid-like or matrix-like arrangement of the different active areas can easily be achieved, thus providing a good lateral resolution of the sensor over the entire seating surface.

In a further embodiment, said optical fibre means comprises a first optical fibre and a second optical fibre, said first and second optical fibre being arranged in series, so that a first end portion of said first optical fibre and a first end portion of said second optical fibre are coaxially aligned in a sensing area of said seating surface. The detecting means then comprises means for detecting a loss of optical energy in said optical fibre means due to a displacement between said end portions of said first and second optical fibre.

In this embodiment, the loss of optical energy due to coaxiality or axial run out between two mechanically spliced fibres may be used to build a sensing device. In fact, if the seat is not occupied, the contiguous end portions of the first and the second fibre are coaxially aligned. This means, that light pulses can pass through the boundary between the two fibres with limited loss of energy. If the sensing area of the seat is deformed by a passenger sitting on the seat, the contiguous end portions are displaced with respect to each other, either axially or radially, and the energy loss at the boundary will increase. The larger the displacement is, the higher is the increase of energy loss in the boundary between the two fibres. Thus, the amount of displacement induced energy loss gives an indication of the amount of displacement between the two fibres and accordingly the pressure acting on the sensing area of the seat.

It will be noted that the two contiguous end portions of the optical fibres represent a single detection device, the sensing range of which is rather limited. In order to detect the occupancy in several sensing areas of the seating surface, the one skilled in the art will provide several optical fibre means of this type, the splices of which are arranged in the different areas of the seat. In this case, the device for sensing occupancy can serve for recording a seating profile, which again can be used for classifying the occupancy.

Since the displacement due to occupancy of the seat takes place substantially in a direction normal to the seating surface, the contiguous end portions of the two fibres are preferably mounted on a support element fixing the lateral position of the two fibre end portions. At least one of said coaxially aligned end portions of said first and second optical fibre is mounted on a flexible support, so that a relative vertical displacement between the two end portions remains possible.

It has to be noted, that in order to reduce the energy loss in the non-occupied state of the seat, a contacting agent, like e.g. a contact gel, can be provided between the contiguous end portions of the two optical fibres.

In a variant of the latter embodiment, the first end portion of the first optical fibre is placed immediately in front of an entrance window of an optical detector. In other words, the second optical fibre in this variant is the entrance window. This means, that the device for sensing occupancy of a seat comprises at least one optical fibre, having a distal end extending towards a sensing area of said seating surface of said seat. Said distal end is arranged in front of an entrance window of an optical detector. The device furthermore comprises detecting means for detecting a loss of optical energy transmitted by said optical fibre towards said optical detector. The detecting means more specifically detects a loss of optical energy due to displacement of said optical fibre with respect to the optical window of said detector. It has to be noted that at least one of said distal end of said fibre means or said optical detector is preferably mounted on a flexible support.

The optical fibre means used in any one of the above described embodiments can comprise one of different existing types of fibres differing in modal type (single mode, multi mode) and the index (graded index, step index and hybrid). Besides these optical glass fibres, there are plastic optical fibres, which have some advantages in comparison with single-mode and multi-mode glass fibres. The higher optical loss of plastic optical fibres, which is considered as a disadvantage in their normal use, constitutes a major advantage for the present invention. In fact the higher optical loss leads to a higher overall energy loss in the fibre and thus to a better output signal. In addition, due to the better ductility of plastic fibres compared to glass fibres, the mechanical characteristics are better suited for the use according to the present invention. Further advantages of plastic fibres compared to glass fibres are the lower price and the simplicity of coupling of the plastic fibres. It follows that said optical fibre means preferably comprises plastic optical fibres.

Rather then expensive laser sources, the light-emitting device advantageously comprises a low cost Light Emitting Diode. It may for instance be an LED diode working in 850 nm wavelength. The light detecting means can e.g. comprise a low price PiN diode. In short, the present invention permits the use of low quality fibre and low quality input and output devices, which at lower production costs lead to an increased overall loss and a better sensor response.

It has to be noted, that a device according to the present invention preferably comprises means for generating a signal indicative of the detected occupancy state of the seat. This signal can then be supplied to a control of a secondary restraint system of a vehicle. Alternatively, the device could be used in the control of a seat heating of a vehicle seat, whereby the seat heating is deactivated when no passenger is present on the seat.

For these applications, said optical fibre means could be woven into a seat cover of said seat or sewed onto a seat cover of said seat. Alternatively, the optical fibre means could be moulded directly into the foam of the seat. Due to its small lateral dimensions, the optical fibre means does not cover a noticeable part of the surface seat even if the fibre extends over the surface in a plurality of

narrow turns. It follows that the sensing device does not constitute a moisture barrier, as other state of the art sensors tend to be. Vapour produced by the passenger can still easily be evacuated downwards through the seat. Furthermore, the optical fibre is not tactile in the seat upholstery, so that the seating comfort of the seat is not at all disturbed by the presence of the sensing device.

Optical fibres do not degrade with increasing age and the optical properties of the optical fibre device will not alter during the lifetime of a vehicle. Therefore, no ageing problem has to be considered with a detecting device of the present invention. Other major advantage of the detecting device of the present invention is the above-described independence of the environmental conditions.

Detailed description with respect to the figures

The present invention will be more apparent from the following description of two not limiting embodiments with reference to the attached drawings, wherein

Fig.1: represents a first embodiment of a device for sensing seat occupancy;
Fig.2: represents a different embodiment of the optical fibre means.

Fig. 1 shows a first embodiment of a device 10 for detecting seat occupancy. It comprises an optical fibre means 12, which extends at least partially over a seating surface 14 of a seat, and a detecting device 16, for detecting a loss of optical energy in the optical fibre means 12.

The optical fibre means 12 comprises a spliced optical fibre 18 with a plurality of optical fibre portions 20 assembled in series. The optical fibre 18 extends over the seating surface 14 in several meanders, so that the fibre portions 20 are arranged in several rows 22 interconnected by bend fibre portions 24. Thus, the different straight fibre portions are arranged at well-defined positions in a grid-like or matrix-like pattern.

Each of these fibre portions 20 constitutes an active sensing element, so that the detecting device comprises a plurality of active sensing elements, which are distributed in a predetermined manner over the seating surface. It has to be noted that the regular distribution of the fibre portions does only serve for

illustration purposes. Depending on the desired resolution of the detector and the design of the seat, specific areas of the seating surfaces can be equipped with more active elements than other areas.

The end portions of the optical fibre 18 are connected to a connecting port 26 of the detecting device 16. This detecting device 16 further comprises a means 28 for detecting a loss of optical energy in each of said optical fibre portions 20. In a most preferred embodiment, this means 28 is an optical time domain reflectometer based device, which is able to detect the amount of attenuation of optical energy in each of the different fibre portions.

If the seat is not occupied by a passenger, each fibre portion 20 has a specific attenuation property, which can be measured once the optical fibre 18 is mounted on the seat. When the seat is occupied, at least some of the optical fibre portions 20 are bend due to the pressure exerted by the passenger on the seat upholstery.

The bend fibre portions have a higher attenuation factor, the difference being proportional to the amount of bending of the fibre. The optical time domain reflectometer based device, which determines the amount of optical loss in each of the fibre portions, can compare the measured values to those of a non-occupied seat and determine the amount of bending of each of the optical fibre portions. In other words, the optical time domain reflectometer based device records a seating profile, which indicates how much pressure is exerted on each sensing area of the seat. By means of an interface 30, this seating profile can be transferred to a control of a secondary restraint system for controlling e.g. an airbag according to the current occupancy status of the seat.

Fig. 2 shows an other embodiment of an optical fibre means 12. This optical fibre means comprises a first optical fibre 32 and a second optical fibre 34. The first and second optical fibres are arranged in series, so that a first end portion 36 of said first optical fibre 32 and a first end portion 38 of said second optical fibre 34 are coaxially aligned when nor force is exerted on the device. The end portions of the two fibres are preferably arranged on a supporting element 40 by means of supporting blocks. The end portion 36 of the first fibre 32 is mounted

on the supporting element 40 by means of an rigid supporting block 42, while the end portion 38 of the second fibre 34 is mounted on the supporting element 40 by means of an elastic supporting block 44.

If a force (shown by arrow 46) is exerted on the junction between the two fibre end portions, the elastic supporting block 44 with the second fibre 34 mounted thereon will be compressed while the rigid supporting block 42 will remain its form. It follows that the two end portions will be displaced with respect to each other, the displacement 48 being depending on the amount of force. The two fibres are no longer coaxial and the energy losses at the junction between the two fibres substantially increases. The larger the displacement is, the higher is the increase of energy loss in the boundary between the two fibres. Accordingly the force acting on the fibre end portions can be evaluated by measuring the energy loss due to a displacement of the two fibres.

Reference List

10	device for detecting seat occupancy
12	optical fibre means
14	seating surface
16	detecting device for detecting a loss of optical energy
18	optical fibre
20	optical fibre portions
22	rows
24	bend fibre portions
26	connecting port
28	means for detecting a loss of optical energy
30	interface
32	first optical fibre
34	second optical fibre
36	first end portion of said first optical fibre
38	first end portion of said second optical fibre
40	supporting element
42	elastic supporting block
42	rigid supporting block
44	elastic supporting block
46	force exerted on the junction between the two fibre end portions

Claims

1. Device for sensing occupancy of a seat, comprising at least one optical fibre means, said optical fibre means extending over at least a part of a seating surface of said seat, and detecting means for detecting a loss of optical energy in said optical fibre means.

2. Device according to claim 1, wherein said optical fibre means comprises at least one optical fibre, said optical fibre extending at least over a part of said seating surface, so that said optical fibre is deformed when said seat is occupied by a passenger, and wherein said detecting means comprises means for detecting a loss of optical energy in said fibre due to a deformation of said fibre.

3. Device according to claim 2, wherein said optical fibre comprises at least two optical fibre portions, said optical fibre portions being assembled in series, and wherein said detecting means comprises means for detecting a loss of optical energy in each of said optical fibre portions.

4. Device according to claim 1, wherein said optical fibre means comprises a first optical fibre and a second optical fibre, said first and second optical fibre being arranged in series, so that a first end portion of said first optical fibre and a first end portion of said second optical fibre are coaxially aligned in a sensing area of said seating surface, and wherein said detecting means comprises means for detecting a loss of optical energy in said optical fibre means due to a displacement between said end portions of said first and second optical fibre.

5. Device according to claim 4, wherein at least one of said coaxially aligned end portions of said first and second optical fibre is mounted on a flexible support.

6. Device according to any one of the preceding claims, characterised in that said detecting means comprises an optical time domain reflectometer.

7. Device for sensing occupancy of a seat, comprising at least one optical fibre means, said optical fibre having a distal end extending towards a sensing area of said seating surface of said seat, said distal end being arranged in front of an entrance window of an optical detector, and detecting means for detecting a loss of optical energy transmitted by said optical fibre towards said optical detector.

8. Device according to claim 7, wherein at least one of said distal end of said fibre means or said optical detector is mounted on a flexible support.

9. Device according to any one of the preceding claims, wherein said optical fibre means comprises plastic optical fibres.

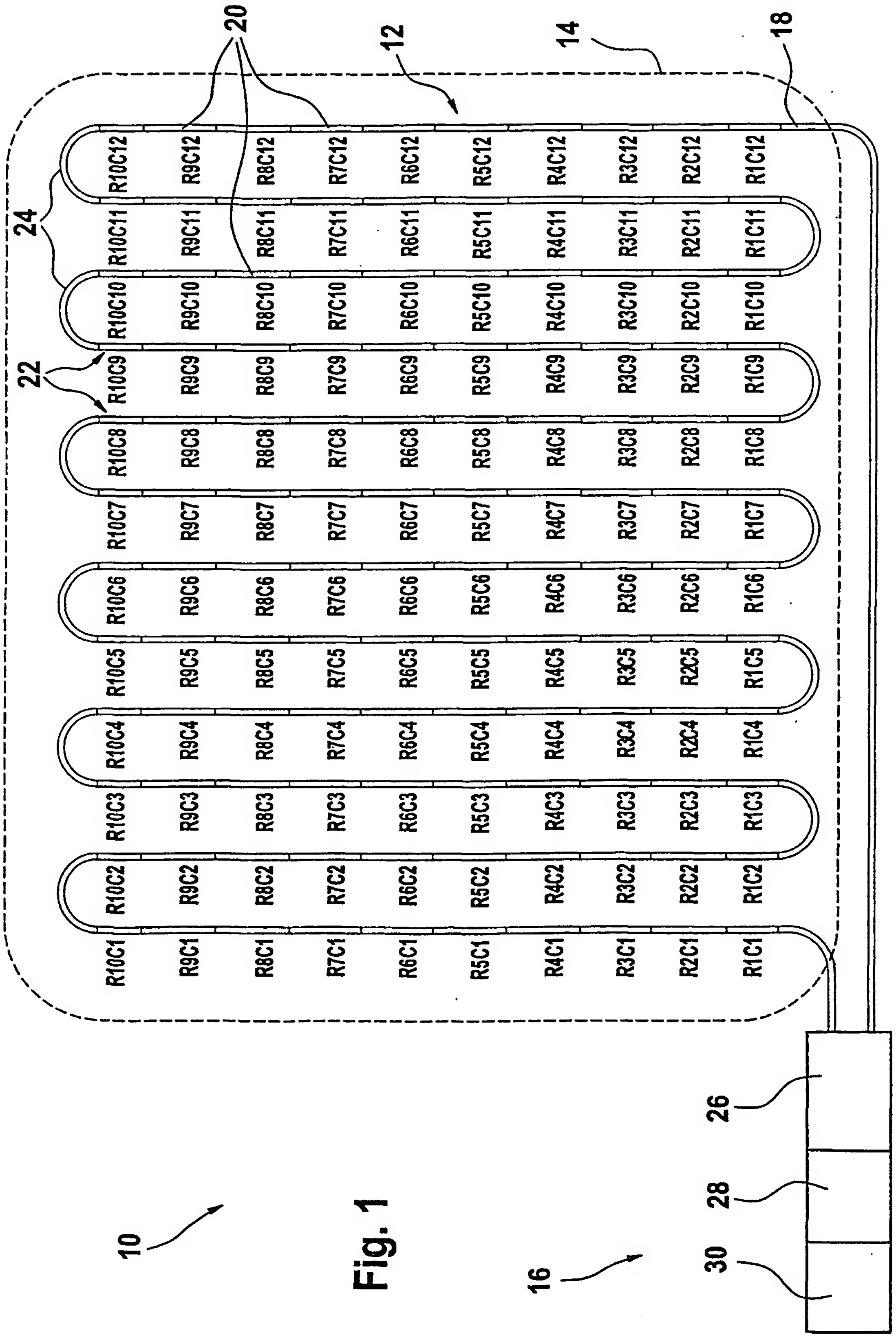
10. Vehicle seat comprising a device according to any one of claims 1 to 8.

11. Vehicle seat according to claim 10, wherein said optical fibre means is woven into a seat cover of said seat.

12. Vehicle seat according to claim 10, wherein said optical fibre means is sewed on a seat cover of said seat.

13. Use of the device according to any one of claims 1 to 8 in the control of a secondary restraint system of a vehicle.

14. Use of the device according to any one of claims 1 to 8 in the control of a seat heating of a vehicle seat.



10
12
14
16
18
20
22
24
26
28
30
R10C12 R9C12 R8C12 R7C12 R6C12 R5C12 R4C12 R3C12 R2C12 R1C12
R10C11 R9C11 R8C11 R7C11 R6C11 R5C11 R4C11 R3C11 R2C11 R1C11
R10C10 R9C10 R8C10 R7C10 R6C10 R5C10 R4C10 R3C10 R2C10 R1C10
R10C9 R9C9 R8C9 R7C9 R6C9 R5C9 R4C9 R3C9 R2C9 R1C9
R10C8 R9C8 R8C8 R7C8 R6C8 R5C8 R4C8 R3C8 R2C8 R1C8
R10C7 R9C7 R8C7 R7C7 R6C7 R5C7 R4C7 R3C7 R2C7 R1C7
R10C6 R9C6 R8C6 R7C6 R6C6 R5C6 R4C6 R3C6 R2C6 R1C6
R10C5 R9C5 R8C5 R7C5 R6C5 R5C5 R4C5 R3C5 R2C5 R1C5
R10C4 R9C4 R8C4 R7C4 R6C4 R5C4 R4C4 R3C4 R2C4 R1C4
R10C3 R9C3 R8C3 R7C3 R6C3 R5C3 R4C3 R3C3 R2C3 R1C3
R10C2 R9C2 R8C2 R7C2 R6C2 R5C2 R4C2 R3C2 R2C2 R1C2
R10C1 R9C1 R8C1 R7C1 R6C1 R5C1 R4C1 R3C1 R2C1 R1C1

Fig. 1

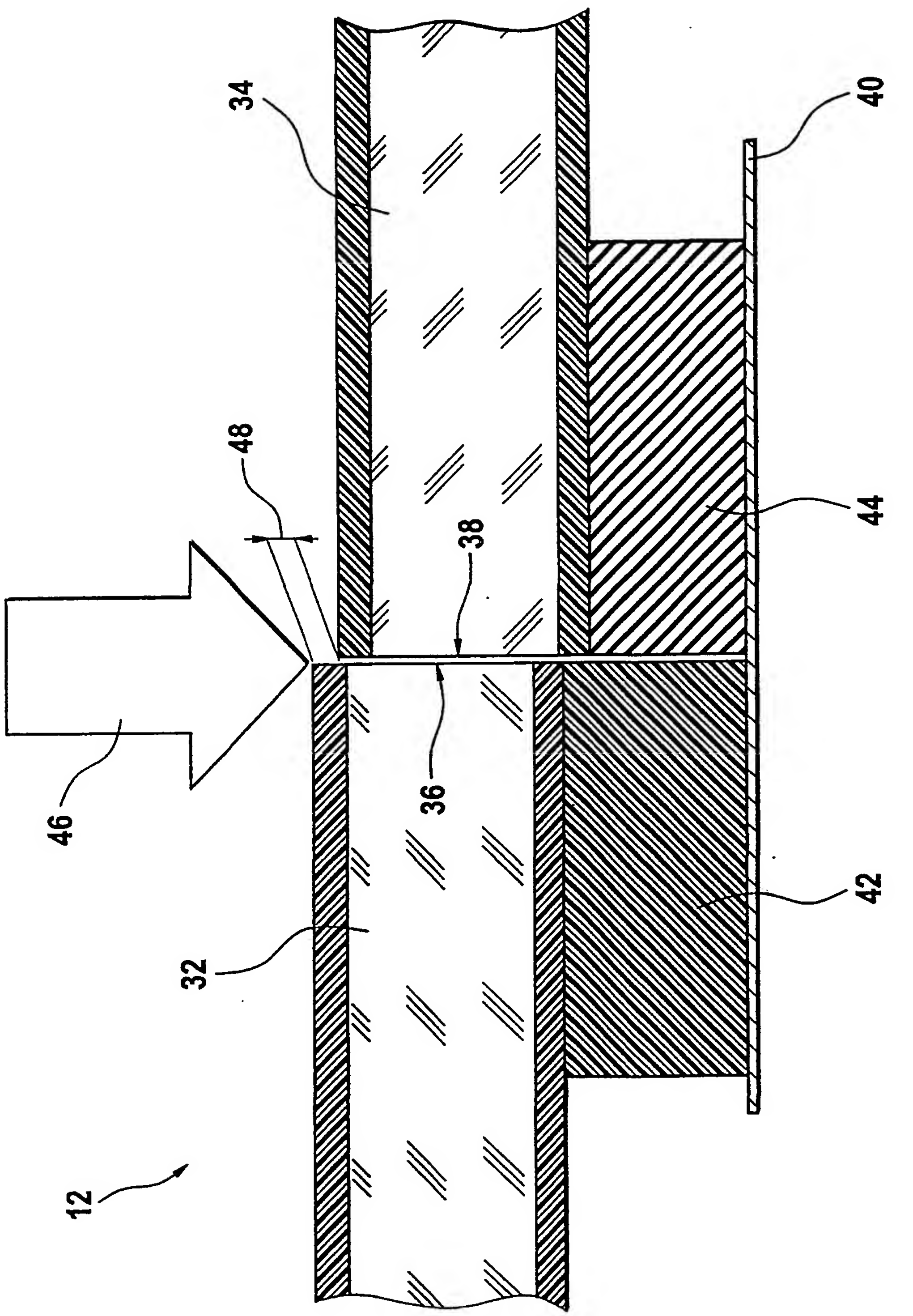


Fig. 2

INTERNATIONAL SEARCH REPORT

I onal Application No
. . ., EP 01/09288

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60N2/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 197 51 677 A (HIPP JOHANN) 27 May 1999 (1999-05-27)	1,10
A	the whole document	7,13,14
X	EP 0 919 426 A (TELEFUNKEN MICROELECTRON) 2 June 1999 (1999-06-02)	1,10
A	the whole document	7,13,14
A	DE 38 02 159 A (PORSCHE AG) 3 August 1989 (1989-08-03) the whole document	1,7,10, 13,14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2002	31/01/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Horváth, R

INTERNATIONAL SEARCH REPORT

nformation on patent family members

Ir onal Application No
ı ʋ ı , EP 01/09288

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 19751677	A	27-05-1999	DE	19751677 A1	27-05-1999
EP 0919426	A	02-06-1999	DE	19752822 A1	10-06-1999
			EP	0919426 A1	02-06-1999
DE 3802159	A	03-08-1989	DE	3802159 A1	03-08-1989